DSM

ENVIRONMENTAL SERVICES INCORPORATED

PHASE II: SUBSURFACE PRODUCT DELINEATION AND FORMATION EVALUATION WORK PLAN EPA I.D. PRD091017228

LETTER REPORT ON THE FINDINGS OF THE OFF-PROPERTY SUBSURFACE PRODUCT DELINEATION PROGRAM

PREPARED FOR:

COMMONWEALTH OIL REFINING COMPANY, INC.
(CORCO)
PETROCHEMICAL COMPLEX
PEÑUELAS, PUERTO RICO

DSM PROJECT NO. 1069-10

FEBRUARY 23, 1998

1830 S. Kirkwood Suite 201 A • Houston, Texas 77077 • 281/870-8676

DSM ENVIRONMENTAL SERVICES INC.

February 22, 1998

Mr. Richard Krauser
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region II
HAZARDOUS WASTE FACILITY BRANCH
290 Broadway, 22nd Floor
New York, NY 10007-1866

Re: Commonwealth Oil Refining Company
Phase II: Subsurface Product Delineation and Formation Evaluation Work Plan
Letter Report – Findings of the Off-Property Subsurface Product Delineation Program
EPA I. D. PRD091017228

Dear Mr. Krauser:

DSM Environmental Services, Inc. (DSM), on behalf of the Commonwealth Oil Refining Company (CORCO) presents the following Off-Property Subsurface Product Delineation letter report ("Report") describing the findings of the off-property subsurface product delineation project and identifying the zero-line for subsurface free-phase product on the ground water. This work was performed in accordance with EPA correspondence of April 24, 1996, at the CORCO facility in Peñuelas, Puerto Rico. This Report completes the subsurface product delineation portion (Step #2) of the ***Phase II: Subsurface Product Delineation and Formation Evaluation Work Plan*** as approved by EPA.

A total of four (4) soil borings and eight (8) delineation wells were completed at the CORCO facility and on neighboring properties during this program. An additional well, installed for a different engineering project, is also included in the hydrogeologic evaluation of the facility. Geologic logs of these borings and delineation wells are included as **Attachment A.** The findings associated with the completed soil borings and delineation wells are discussed below.

SOIL BORINGS

A total of four (4) soil borings were completed at the CORCO facility during this program. The soil borings are identified as IDW-1, IDW-2, IDW-3, and IDW-4. The location of these borings is shown on **Figure 1, Boring and Delineation Well Location Plan.**

The soil borings were completed on the CORCO property south of Highway 127 to further determine the geology of the formations south of Highway 127 and to determine the location and depths of delineation wells scheduled for installation to accurately monitor the ground water conditions in the area. Previous investigations determined that most of the CORCO property south of Highway 127 is comprised of a top layer of limestone (caliche) fill that varies in thickness from a few inches to approximately 20 feet in some areas. This fill was placed on a

natural layer of clay that overlies the lower sediments. Within this fill and generally at the interface of the fill and the clay, a discontinuous, perched water table has developed that is not connected to the underlying sediments or the ground water contained in them. The borings done as part of this program confirmed the earlier analyses of the geology of the area south of Highway 127. Specifically, in all borings and subsequently installed delineation wells, a clay layer that ranges in thickness from approximately four (4) to ten (10) feet was found below the fill material. This clay layer is continuous in the area of the soil borings and delineation wells and extends southward and westward from the point where the Ponce Limestone plunges beneath the surface.

Below the clay layer, in borings IDW-1, IDW-2, IDW-3, and IDW-4, are interbedded silts, sands and clays that extend down as far as 60 feet below the surface before the underlying Ponce Limestone is encountered. These deposits are alluvial in origin and appear to be ancient channel deposits from the delta of the Tallaboa River. At present, we do not have enough data points in these alluvial formations to determine the ground water flow direction, but we assume that it is generally southward, toward Tallaboa Bay with possibly some westward, lateral movement along buried, distributary channels parallel to the limestone front. In the area to the west of the IDW-1 and IDW-2 borings, the clay layer continues, but is underlain by peat beds. The total area underlain by the peat beds is not known. Some of these peat beds are up to 15 feet thick and, where they are present, ground water is first encountered in them.

The clay layer immediately under the fill acts as a confining or semi-confining layer for the underlying ground water in the sand and gravel alluvial deposits as well as in the layers of peat. Phase-separated hydrocarbon was not found in any of the alluvial or peat samples from the borings or in the ground water.

The location of these borings and the location of the Hydrogeologic Cross Sections are shown on **Figure 1, Boring and Delineation Well Location Plan.** Cross sections, with geologic interpretation of the area south of Highway 127, are shown on **Figure 2, Hydrogeologic Cross Sections.**

DELINEATION WELL INSTALLATIONS

A total of eight (8) delineation wells were completed at the CORCO facility and on neighboring properties during this program. The delineation wells are identified as PDW-1, PDW-2, PDW-3, PDW-4, PDW-5, PDW-6, PDW-7, and PDW-8. An additional geotechnical engineering well, identified as SWP-1, was installed under a different project but is included in this report. The approximate location of these wells is shown on **Figure 1, Boring and Delineation Well Location Plan.**

Two of the eight delineation wells (PDW-1and PDW-8) and SWP-1 were installed in the sediments south of Highway 127 on CORCO property. PDW-2 was installed on the Union Carbide Caribe property, just to the south of the southeast corner of the adjacent Pearl Chemical Company property. Another of the delineation wells, PDW-3, was installed in the Tallaboa River sediments to the east of the CORCO property, on what is now the HERCOR property. Two of the remaining four delineation wells (PWD-4 and PDW-5) were installed in the north central area of the CORCO facility. PDW–6 was installed on the northwest property boundary between the

CORCO facility and the Sucesion Mercado Riera property. The remaining well, PDW-7, was installed on the Sucesion Mercado Riera property, north of the PREPA tank farm. The approximate location of these wells is shown on **Figure 1, Boring and Delineation Well Location Plan.** None of these delineation wells or the geotechnical engineering well encountered free product at the time of installation. These new wells, combined with the wells that were installed in previous delineation projects, have delineated the extent of the phase-separated plume at the CORCO facility.

Delineation wells PDW-1, PDW-2, PDW-8, and the geotechnical engineering well SWP-1 are located in the alluvial deposits south of Highway 127. In the drilling of PDW-1, a saturated peat layer approximately eight (8) feet thick was encountered below the first clay layer. Below this peat layer was a clay layer at least four (4) feet thick. Because the water in the peat represents the first ground water and, therefore, the most probable location to encounter phase-separated hydrocarbons, the well screen was set in the peat. In the drilling of SWP-1, a four foot thick, gray, organic clay extended from below the base of the of fill to the top of an interbedded sequence of blue-gray, marine clay and peat. This clay-peat sequence was saturated and represented the first ground water. The well screen was set in this material. In PDW-2 and PDW-8, the clay-overlying-alluvial-formation sequence that was encountered in the IDW series soil borings was found in the borings for these wells. The alluvium was saturated and represented the first encounter with the ground water. Therefore, the well screens were set in these alluvial deposits. No free phase hydrocarbon product was detected in any of these wells.

In PDW-3, on the HERCOR property, a different sequence of sediments was found. In this well, starting at the surface, the alluvial deposits consisted of interbedded loam, silt and clay. Below the surficial loam, interbedded silt and clay was found which graded vertically downward into very thin layers of saturated sand and sandy silt. A distinct, underlying clay layer was not found. The alluvium in this area is more representative of over bank and/or flood plain deposits of the Tallaboa River. Ground water was encountered in this well, but no free-phase hydrocarbons were detected.

PDW-4 and PDW-5 are located in the north central area of the CORCO facility. These wells were drilled and completed in the Ponce Limestone. Ground water was encountered at 6.4 and 4.7 feet above sea level, respectively, in these wells, and no free-phase hydrocarbons were detected.

PDW-6 was drilled and completed in the Ponce Limestone, at the bottom of a ravine on the northwest property boundary of the CORCO facility. The location is just to the northwest of the MIS area. Ground water in this well was encountered at 5.8 feet above sea level. No phase-separated hydrocarbons were encountered at the time that the well was installed, but in the latest monitoring event (November 6, 1997), approximately 0.01 feet of phase separated product was measured in this well. There are no locations that are accessible for a drill rig to extend the search farther north or west in this area because of the PREPA power line corridor.

Assumptions were made in the past regarding the effect of the ravine on the western border of the CORCO facility. The ravine in question has an ephemeral stream at its bottom, the bed of which is in the Ponce Limestone. Any surface water from precipitation events runs off in the ravine very rapidly, and any small, remaining pools in the streambed appear to evaporate faster than they can infiltrate. A comparison of the ground water elevations in wells located on both sides of

the ravine and in the bottom of the ravine indicates that there is a general gradient of the ground water to the south and southwest. This gradient is smooth across the area of the ravine, which indicates that this surficial feature does not affect the movement of ground water in the area.

PDW-7 was drilled and completed in the Ponce Limestone on the north side of the PREPA tank farm, west of the CORCO facility. As with the other Ponce Limestone wells, ground water was encountered at an elevation slightly above sea level, 3.68 feet, and no free product was found.

In all of the product delineation wells and the geotechnical engineering well that were installed south of Highway 127, the ground water levels that were measured in the wells are above the base of the overlying clay, indicating that the ground water in the area is confined or semi-confined.

PRODUCT PLUME LOCATION

As indicated in previous reports, and as confirmed by this investigation, the phase-separated product plume on the ground water at the CORCO facility is confined to an area north of Highway 127 that is bounded by the Shell Oil Company property on the west and the HERCOR property on the east. Past subsurface investigations conducted in 1992 at the Shell Property (***Environmental Property Assessment Report, Shell Fuel Terminal, Guayanilla, Puerto Rico***, March 5, 1992) and letter reports in 1993, 1995, and 1996, report the presence of free-phase product underlying the Shell property; however, no confirmatory sampling of existing wells on the Shell property was conducted to ascertain the current presence, or absence, of free-phase product. The origin and current extent of free-phase product underlying the Shell property is not known. Monitoring wells have been installed on all sides of the CORCO facility in areas where phase-separated hydrocarbons do not exist or the measured thickness is very small. The former product delineation well, DW-6, which was used as a monitoring point in previous evaluations of the extent of free-phase product, has been eliminated from this evaluation because it was constructed in the fill material and does not represent true ground water conditions. Also, product delineation wells PD-1 through PD-8 and pumping test well PT-4, which are all constructed in the fill material south of Highway 127, were eliminated from the evaluation. **Figure 3, Phase-Separated Hydrocarbon Thickness Map** shows the boundaries of the plume defined by this Phase II: Off-Property Subsurface Product Delineation Project.

In previous presentations of similar data, the thicknesses shown on the isopach maps were uncorrected thickness, that is, the actual thickness of product measured in the well instead of the corrected thickness of free-product that was present in the formation. This method of reporting portrays the free-phase hydrocarbon contamination in the subsurface in a manner that makes the volume of free-phase product appear greater than it actually is. Therefore, the product thicknesses shown on **Figure 3, Phase-Separated Hydrocarbon Thickness Map** have been corrected to represent the corrected, calculated thickness of hydrocarbon product in the formation. The calculated thickness of free-phase product in the formation is based on calculations that were developed by Blake and Hall in 1984 (Blake, S. B. And Hall, R. A.; 1984;

Monitoring Petroleum Spills with Wells: Some Problems and Solutions; Proceedings: 4th National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, NGWA, Columbus, OH)

SUMMARY

This Off-Property Subsurface Product Delineation Project has delineated the horizontal and vertical extent of the free-phase hydrocarbon product plume that is associated with the CORCO facility in Peñuelas, Puerto Rico and represents the completion of the Free-Phase Product Delineation portion (Step#2) of **the *Phase II – Subsurface Product Delineation and Formation Evaluation Work Plan***. As was shown in earlier evaluations, and confirmed in this study, the plume is confined to the Ponce Limestone, north of Highway 127, by naturally occurring, geologic barriers.

The project data also has confirmed that there is a continuous clay layer underlying the fill material south of Highway 127 that acts as a confining or semi-confining aquitard for the ground water in the alluvial sediments that underlie the clay layer.

Based on the completion of the delineation portion of the ***Phase II – Subsurface Product Delineation and Formation Evaluation Work Plan*** CORCO will proceed with the next step in the overall evaluation of the free-phase hydrocarbons, which is the development of a computer simulation of the hydrogeologic regime at and near the facility. This computer simulation will be used in the development of a remediation plan for the site.

If you have any questions or comments please call us at (281) 870 – 8676.

Sincerely,
DSM Environmental Services, Inc.

Joe H. Rafferty
President

Attachments:
Figure 1. Boring and Delineation Well Location Plan
Figure 2. Hydrogeologic Cross Sections
Figure 3. Phase-Separated Hydrocarbon Thickness Map
Appendix A: Geologic Well Logs

cc: Mr. Israel Torres, PREQB
Mr. Dale Byars - CORCO
Mr. Roberto Gratacos - CORCO
Mr. Edert Ortiz - CORCO
DSM File: 1069-10, 22.0

crg/CG

DSM Project No. 1069-10
DSM File No.: 1069-10; 22.0

APPROX. CORCO SITE BOUNDARY

HIGHWAY 2

HIGHWAY 2

HIGHWAY 127

HIGHWAY 127

RAVINE

PDW-7 PDW-6 PDW-5 PDW-4 PDW-3 PDW-2 PDW-1

DW-1 DW-2 DW-3 DW-4 DW-5 DW-6 DW-7

MW-1 MW-2 MW-3 MW-4 MW-5 MW-6

PT-1 PT-2 PT-3 PT-4 PT-5

PD-1 PD-2 PD-3 PD-4 PD-5 PD-6 PD-7 PD-8 PD-9 PD-10 PD-11 PD-12 PD-13 PD-14 PD-15 PD-16 PD-17 PD-18 PD-19 PD-20 PD-21 PD-22 PD-23 PD-24 PD-25 PD-26 PD-27 PD-28 PD-29 PD-30 PD-31 PD-32

EPRB-1 EPRB-2 EPRB-4 EPRB-5 EPRB-6

IDW-1 IDW-2 IDW-3 IDW-4

SWP-1

1023 1024 755 492 1020 1019 1018 1017 1021 109 1016 723

A A' B B' C C'

LEGEND

PDW-1	OFF SITE DELINEATION WELL
PT-2	PHASE II PUMP TEST WELL
EPRB-1	EXPERIMENTAL PRODUCT RECOVERY DELL
DW-6	PHASE II DELINEATION WELL
PD-6	PHASE I & MIS AREA MONITORING WELL
A A'	CROSS SECTION LOCATION

0 300 600

SCALE IN FEET

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CORCO
BORING AND DELINEATION WELL LOCATION PLAN

PROJECT: 1069-01	DRAWN BY: MWH	CHK'D BY:	REV:
DATE:	SCALE: 1"=600'	FIGURE: 1	DB NUMBER:

APPROX. CORCO SITE BOUNDARY

HIGHWAY 2

HIGHWAY 2

HIGHWAY 127

HIGHWAY 127

RAVINE

LEGEND

- 1.0 — PRODUCT THICKNESS CONTOUR INTERVAL 0.5 ft.
- PDW-1 — OFF SITE DELINEATION WELL
- PT-2 — PHASE II PUMP TEST WELL
- EPRB-1 — EXPERIMENTAL PRODUCT RECOVERY DELL
- DW-6 — PHASE II DELINEATION WELL
- PD-6 — PHASE I & MIS AREA MONITORING WELL

0 300 600
SCALE IN FEET

DSM ENVIRONMENTAL SERVICES, INC.

CORCO PHASE SEPARATED HYDROCARBON THICKNESS MAP

PROJECT: 1069-01	DRAWN BY: MWH	CHK'D BY:	REV:
DATE:	SCALE: 1"=600'	FIGURE: 3	DB NUMBER:

ATTACHMENT A

WELL LOGS

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SOIL BORING LOG

Boring No.: IDW-1

Project: Off-site Delineation
Client: CORCO
Project No.: 1069-10
Logged by: C. R. Glore
Date: 07/15/97

Total Depth: 52 Feet
Location: CORCO Refinery, PR
Elevation: 8.31 Feet
Depth to Water: 26.5
Drilling Co.: SoilTech Corporation
Driller: Jorge Diaz
Drilling Method: Hollow Stem Auger
Sampling Method: Splilt Spoon

Notes: 90 deg. F; Partly Cloudy

Depth	Elevation	Lithology	USCS	SPT	Core Recovery	PID (ppm)	Samples and Water Level	Lithologic Description
0					12/60"			FILL: Crushed limestone ("caliche")
	0				13/60"			
0				N/A		N/A		
					12/60"			
	-10				0/60"			
-20					6/24"			
			CL		6/24"			CLAY: stiff, some fill mixed in, some natural gravel, tan and gray; becomes v. stiff and color changes to red & brown in bottom 2 ft.
					22/24"		▼	
	-20				24/24"			ALLUVIUM: saturated, interbedded, well rounded, fine to coarse sand, fine to medium (<1" dia.) gravel, some thin layers (<1') of silt, very small amounts of shell hash; mostly dark gray to v. dark gray
0					24/24"			
					9/24"			
					24/24"			
			GP		19/24"			
					22/24"			

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SOIL BORING LOG

Boring: IDW-1

Project Name: Off-site Delineation
Project Number: 1069-10
Project Date: 07/15/97
Depth: 52 Feet

Depth	Elevation	Lithology	USCS	SPT	Core Recovery	PID (ppm)	Samples and Water Level	Lithologic Description
40	-30				8/24"			
					18/24"			
					16/24"			
					16/24"			
					9/24"			
	-40							PONCE LIMESTONE: interbedded calcareous clay and thin beds of reef limestone, fossiliferous, top few feet saturated and low strength
50					3/24"			
					13/24"			

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SOIL BORING LOG

Boring No.: IDW-2

Project:	Off-site Delineation
Client:	CORCO
Project No.:	1069-10
Logged by:	C. R. Glore
Date:	07/16/97

Total Depth:	60 Feet
Location:	CORCO Refinery, PR
Elevation:	9.90 Feet
Depth to Water:	12 Feet
Drilling Co.:	SoilTech Corporation
Driller:	Jorge Diaz
Drilling Method:	Hollow Stem Auger
Sampling Method:	Splilt Spoon

Notes: 90 deg. F; Partly Cloudy

Depth	Elevation	Lithology	USCS	SPT	Core Recovery	PID (ppm)	Samples and Water Level	Lithologic Description
0					18/24"			FILL: crushed limestone fill ("caliche")
					11/24"			
					14/24"			
					14/24"			
10	0		CL	N/A	6/24"	N/A		CLAY: very plastic, saturated, some root fragments, blue-gray color, H2S odor
					22/24"			
			Pt		24/24"			PEAT: saturated, H2S odor
			Pt/OH		21/24"			CLAY AND PEAT: very plastic, blue-gray, H2S odor
			OH/Pt		24/24"			CLAY: stiff, some root fragments, blue-gray, H2S odor
-20	-10		OH		24/24"			CLAY: stiff, some peat fragments, green-brown, no odor
					19/24"			CLAY: very stiff, caliche nodules, gray, grading to brown and green, v. sm. amount of silt in bottom 2"
			CL		6/24"			
					24/24"		▼	CLAY: plastic, saturated, caliche nodules and shell fragments, some coral fossils
			CL		24/24"			SANDY CLAY: saturated, shell fragments and fine gravel, more CL toward bottom, bottom 6" pure caliche
0	-20		CL		17/24"			CLAY: very stiff, caliche and iron nodules, some well rounded, fine gravel, sl. more plastic and lg. amount of caliche in bottom 6"
					8/24"			
					20/24"			
					19/24"			GRAVEL AND SAND: coarse (1" dia.), saturated, grades downward to finer gravels and an organic sand/silt mixture, 1" charcoal at bottom
			SP		24/24"			

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SOIL BORING LOG

Boring: IDW-2

Project Name: Off-site Delineation
Project Number: 1069-10
Project Date: 07/16/97
Depth: 60 Feet

Depth	Elevation	Lithology	USCS	SPT	Core Recovery	PID (ppm)	Samples and Water Level	Lithologic Description
0	-30		SP		24/24"			SILT SAND GRAVEL: saturated, medium to fine grain sand, fine grain gravel, brown
					15/24"			
					18/24"			
					22/24"			
					24/24"			
-50	-40				24/24"			
					24/24"			
					22/24"			

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SOIL BORING LOG

Boring No.: IDW-3

Project:	Off-site Delineation
Client:	CORCO
Project No.:	1069-10
Logged by:	C. R. Glore
Date:	07/22/97

Total Depth:	56 Feet
Location:	CORCO Refinery, PR
Elevation:	21 Feet
Depth to Water:	28 Feet
Drilling Co.:	SoilTech Corporation
Driller:	Jorge Diaz
Drilling Method:	Hollow Stem Auger
Sampling Method:	Splilt Spoon

Notes: 90 deg. F; Partly Cloudy

Depth	Elevation	Lithology	USCS	SPT	Core Recovery	PID (ppm)	Samples and Water Level	Lithologic Description
0	20				6/60			FILL: Crushed Limestone ("caliche")
					6/12			
					22/24			
10	10			N/A	13/24	N/A		
					18/24			
					16/24			
					24/24			
					17/24			
-20	0				24/24			
					7/24			
			CL		18/24			CLAY: very stiff, dry, red with caliche and iron nodules, sm. amt. fine gravel toward bottom
					0/24		▼	
					8/24			
30	-10				5/24			SAND AND GRAVEL: alluvium, saturated, coarse sand, dark green, increasing gravel with depth
					24/24			
			GM		12/24			
					6/24			
								GRAVEL: alluvium, saturated, well rounded, some cobbles

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SOIL BORING LOG

Boring: IDW-3

Project Name: Off-site Delineation
Project Number: 1069-10
Project Date: 07/22/98
Depth: 56 Feet

Depth	Elevation	Lithology	USCS	SPT	Core Recovery	PID (ppm)	Samples and Water Level	Lithologic Description
40	-20		GP		0/96			intermixed, increasing sand with depth
					15/24			
50	-30		SW		18/24			SAND: saturated, coarse grain, dark gray to black
					24/24			
					12/24			PONCE LIMESTONE
					15/24			
60								

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SOIL BORING LOG

Boring No.: IDW-4

Project: Off-site Delineation
Client: CORCO
Project No.: 1069-10
Logged by: C. R. Glore
Date: 07/18/97

Total Depth: 62 Feet
Location: CORCO Refinery, PR
Elevation: 11.01 Feet
Depth to Water: 28 Feet
Drilling Co.: SoilTech Corporation
Driller: Jorge Diaz
Drilling Method: Hollow Stem Auger
Sampling Method: Splilt Spoon

Notes: 90 deg. F; Partly Cloudy

Depth	Elevation	Lithology	USCS	SPT	Core Recovery	PID (ppm)	Samples and Water Level	Lithologic Description
0	10				12/24			FILL: Crushed Limestone ("caliche")
					17/24			
					2/24			
					18/24			
					6/24			
0	0		SC	N/A	15/24	N/A		SANDY CLAY: med. plastic, sm. amt. coarse sand, gray-brown
					17/24			CLAY AND GRAVEL: saturated, plastic, well rounded gravel mixed in clay (<1/2" dia.), some caliche nodules and coarse sand, gray-brown
					18/24			
			CL		20/24			
-20	-10				16/24			
					21/24			
					0/24			
					19/24			
					24/24		▼	
0					17/24			
	-20		SP		24/24			ALLUVIUM: saturated, interbedded silt, sand and gravel; sand is med. to coarse grain, rounded; gravel is fine to med. grain, well rounded; all are dark brown to black
					24/24			
					24/24			
					6/24			

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SOIL BORING LOG

Boring: IDW-4

Project Name: Off-site Delineation
Project Number: 1069-10
Project Date: 07/18/97
Depth: 62 Feet

Depth	Elevation	Lithology	USCS	SPT	Core Recovery	PID (ppm)	Samples and Water Level	Lithologic Description
0	-30		ML		12/24 24/24 24/24 24/24			SILT: saturated, small amounts of fine sand and gravel interbedded, 43.6-44'; 4" CLAY, v. stiff,dry w/caliche and fine gravel
-50	-40		ML		24/24 24/24 24/24			SILT AND CLAY: saturated, interbedded, some coarse sand and fine gravel lenses with clay balls in them, some small, angular limestone pieces
			MH		24/24 24/24 23/24			SILT: saturated, some gravel and sand in bottom 1', brown
0	-50				24/24 18/24			PONCE LIMESTONE

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MONITORING WELL

Well No: PDW-1

Project: Off-site Delineation
Client: CORCO
Project No.: 1069-10
Logged by: C. R. Glore
Date: 07/21/97

Well Type: Monitoring
Well Material: PVC Casing & Screen
Total Depth: 24 Feet
Location: CORCO Refinery, PR
Elevation: 9.58 Feet
Depth to Water: 8 Feet
Drilling Co.: SoilTech Corporation
Driller: Jorge Diaz
Drilling Method: Hollow Stem Auger

Notes: 90 deg. F; Cloudy, Drizzle

Depth	Elevation	Lithology	SPT	Core Recovery	USCS/PID	Samples	Lithologic Description	Well Diagram	Well Description
0							FILL: Crushed Limestone ("caliche")	Grout	CASING
				12/24					
				14/24					
				17/24					
				7/24	OH		CLAY: fat, plastic, saturated, some fill mixed in top of core, possibly organic, dark gray to black	Bentonite	
10	0		N/A	9/24			PEAT: saturated, some thin, blue-gray marine clay layers, strong H2S odor		SCREEN
				24/24	Pt				
				2/24					
				18/24				Sand	
				18/24			CLAY: plastic, marine, some root fragments, H2S odor, blue-gray		
-20	-10			24/24	OH				SUMP
30	-20								

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MONITORING WELL

Well No: PDW-2

Project:	Off-site Delineation
Client:	CORCO
Project No.:	1069-10
Logged by:	C. R. Glore
Date:	08/06/97

Well Type:	Monitoring
Well Material:	PVC Casing & Screen
Total Depth:	32 Feet
Location:	Union Carbide Caribe Facility
Elevation:	16.19 Feet
Depth to Water:	14 Feet
Drilling Co.:	SoilTech Corporation
Driller:	Jorge Diaz
Drilling Method:	Hollow Stem Auger

Notes: 90 deg. F; Partly Cloudy

Depth	Elevation	Lithology	SPT	Core Recovery	USCS/PID	Samples	Lithologic Description	Well Diagram	Well Description
0				12/24			FILL: Crushed Limestone ("caliche"), saturated in bottom 2 ft., dark gray, strong hydrocarbon odor	Grout	
	10			17/24					
				14/24					
				17/24	CL				
-10			N/A	13/24				Bentonite	CASING
				10/24					
				21/24	CH		CLAY: sl. plastic, some intermixed fine, rounded gravel(<20%), caliche and iron nodules, brown		
				26/24			CLAY: saturated, plastic, gray and brown		
	0						CLAY: top 2 ft. sl. plastic, remainder v. stiff, some intermixed fine, rounded gravel (<20%), caliche and iron nodules, brown		
				18/24	SC				
-20				12/24		▼		Sand	
				17/24			CLAY AND SAND: saturated; sand is coarse grained, bedded, dark gray; clay is plastic to stiff, bedded, lt. tan		
				23/24					
	-10			24/24					SCREEN
				24/24					
					CL		CLAY: v. stiff, dry, caliche nodules, red and brown mottled		
-30				20/24			CLAY: NOTE: Drilled from 30 to 32 feet with out samples. Same material as 27.5 to 30		SUMP

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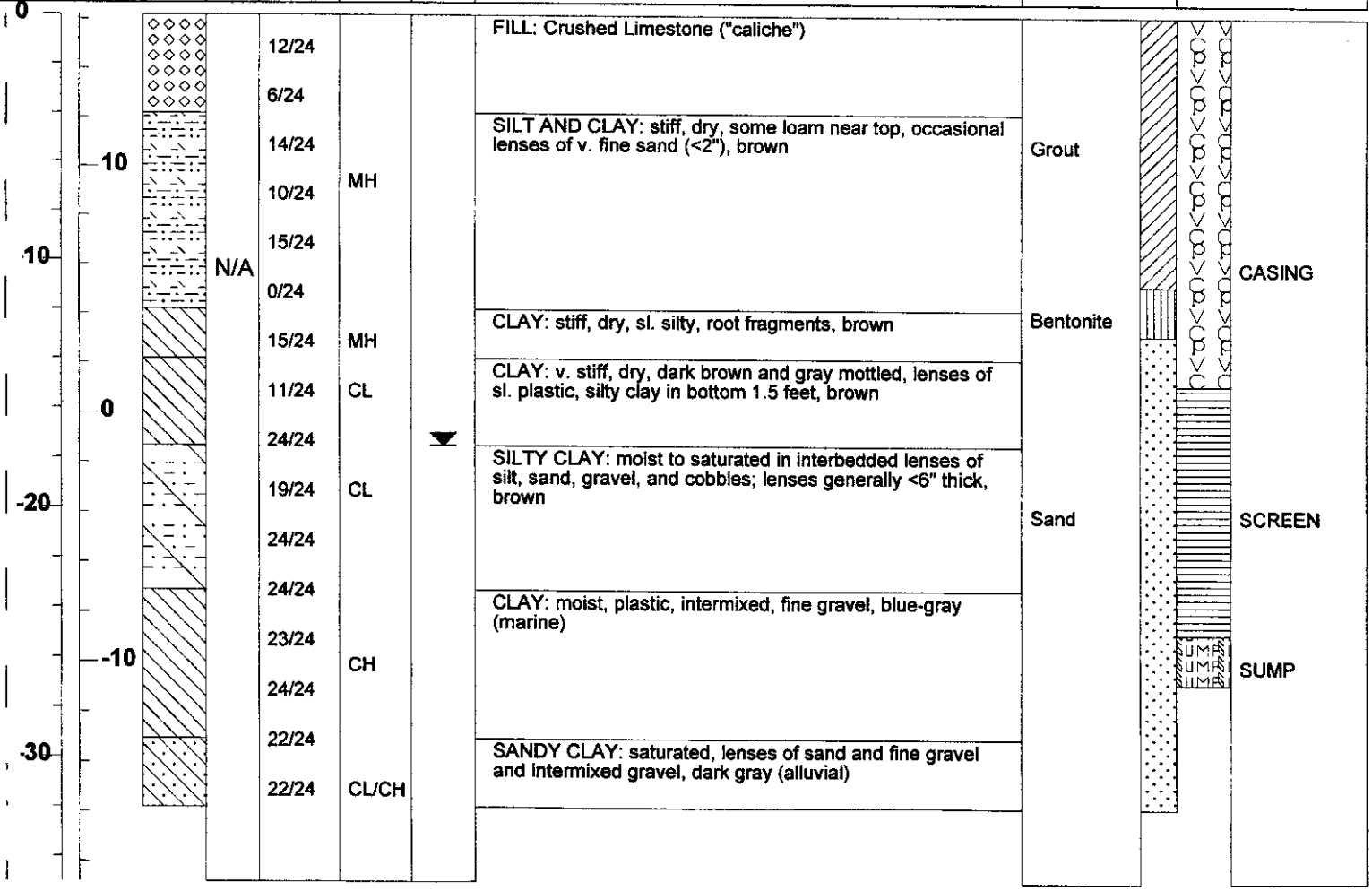
MONITORING WELL

Well No: PDW-3

Project: Off-site Delineation
Client: CORCO
Project No.: 1069-10
Logged by: C. R. Glore
Date: 08/11/97

Well Type: Monitoring
Well Material: PVC Casing & Screen
Total Depth: 32 Feet
Location: HERCOR Refinery, PR
Elevation: 29.47 Feet
Depth to Water: 17.5 Feet
Drilling Co.: SoilTech Corporation
Driller: Jorge Diaz
Drilling Method: Hollow Stem Auger

Notes: 90 deg. F; Partly Cloudy



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MONITORING WELL

Well No: PDW-4

Project: Off-site Delineation
Client: CORCO
Project No.: 1069-10
Logged by: C. R. Glore
Date: 08/05/97

Well Type: Monitoring
Well Material: 4";PVC Casing/SS Screen
Total Depth: 245 Feet
Location: CORCO Refinery, PR
Elevation: 233.75 Feet
Depth to Water: 230 Feet
Drilling Co.: SoilTech Corporation
Driller: Jorge Diaz
Drilling Method: Air Rotary

Notes: 90 deg. F; Partly Cloudy

Depth	Elevation	Lithology	SPT	Core Recovery	USCS/PID	Samples	Lithologic Description	Well Diagram	Well Description
0	230		N/A	N/A	N/A		PONCE LIMESTONE: predominantly dry clay with occasional thin (<5') lenses of limestone and/or reef coral, formation varies in color from white to dark brown, depending on the amount of moisture and iron stain	Grout	CASING
-10	220								
20	210								
30	200								
40	190								
-50							SANDY CLAY: dry, dark gray, numerous root fragments, organic odor.		

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MONITORING WELL

Well No: PDW-4

Project Name: Off-site Delineation
Project Number: 1069-10
Project Date: 08/05/97
Depth: 245 Feet

Depth	Elevation	Lithology	SPT	Core Recovery	USCS/PID	Samples	Lithologic Description	Well Diagram	Well Description
-60	180								
	170								
-70							PONCE LIMESTONE: predominantly dry clay with occasional thin (<5') lenses of limestone and/or reef coral, formation varies in color from white to dark brown, depending on the amount of moisture and iron stain		
	160								
0									
	150								
-90									
	140								
-100					N/A			Grout	CASING
	130								
-110									
	120								
-120									
	110								
-130									

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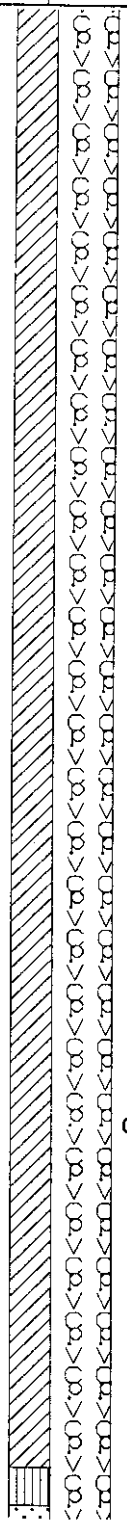
MONITORING WELL

Well No: PDW-4

Project Name: Off-site Delineation
Project Number: 1069-10
Project Date: 08/05/97
Depth: 245 Feet

Depth	Elevation	Lithology	SPT	Core Recovery	USCS/PID	Samples	Lithologic Description	Well Diagram	Well Description
-140	100							Grout	CASING
-150	90								
-160	80								
-170	70								
-180	60								
-190	50								
-200	40							Bentonite	
	30								



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MONITORING WELL

Well No: PDW-4

Project Name: Off-site Delineation
Project Number: 1069-10
Project Date: 08/05/97
Depth: 245 Feet

Depth	Elevation	Lithology	SPT	Core Recovery	USCS/PID	Samples	Lithologic Description	Well Diagram	Well Description
210					N/A				
	20							Sand	
220									
	10								SCREEN
							PONCE LIMESTONE: ground water encountered at approx. 230 ft. below surface (approx. sea level), no free-phase hydrocarbon.		
230						▼			
	0								SUMP
-240									
	-10								

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MONITORING WELL

Well No: PDW-5

Project:	Off-site Delineation
Client:	CORCO
Project No.:	1069-10
Logged by:	C. R. Glore
Date:	07/31/97

Well Type:	Monitoring
Well Material:	4";PVC Casing/SS Screen
Total Depth:	240 Feet
Location:	CORCO Refinery, PR
Elevation:	216.40
Depth to Water:	212 Feet
Drilling Co.:	SoilTech Corporation
Driller:	Jorge Diaz
Drilling Method:	Air Rotary

Notes: 90 deg. F; Partly Cloudy

Depth	Elevation	Lithology	SPT	Core Recovery	USCS/PID	Samples	Lithologic Description	Well Diagram	Well Description
0	216		N/A	N/A	N/A		PONCE LIMESTONE: predominantly dry, calcareous clay with occcasional thin (<5') lenses of limestone and/or reef coral; formation varies in color from white to dark brown to gray, depending on the amount of moisture and iron staining	Grout	CASING
-10	210								
20	200								
30	190								
-40	180								
-50	170								

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MONITORING WELL

Well No: PDW-5

Project Name: Off-site Delineation
Project Number: 1069-10
Project Date: 07/31/97
Depth: 240 Feet

Depth	Elevation	Lithology	SPT	Core Recovery	USCS/PID	Samples	Lithologic Description	Well Diagram	Well Description
-60	160								
-70	150								
	140								
-90	130								
-100	120				N/A			Grout	CASING
110	110								
120	100								
130	90								

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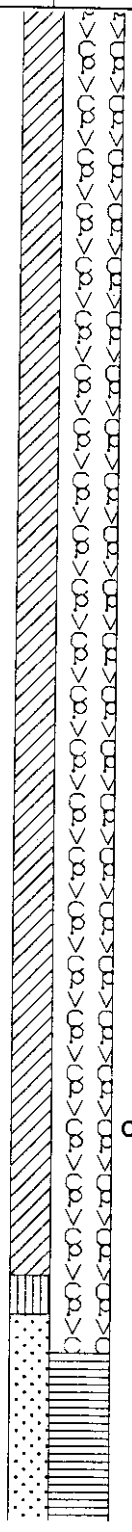
MONITORING WELL

Well No: PDW-5

Project Name: Off-site Delineation
Project Number: 1069-10
Project Date: 07/31/97
Depth: 240 Feet

Depth	Elevation	Lithology	SPT	Core Recovery	USCS/PID	Samples	Lithologic Description	Well Diagram	Well Description
-140	80								
	70								
-150									
-160	60								
	50								
-170									
	40								
-180									
	30								
-190								Grout	CASING
	20								
-200								Bentonite	
	10								



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MONITORING WELL

Well No: PDW-5

Project Name: Off-site Delineation
Project Number: 1069-10
Project Date: 07/31/97
Depth: 240 Feet

Depth	Elevation	Lithology	SPT	Core Recovery	USCS/PID	Samples	Lithologic Description	Well Diagram	Well Description
210					N/A				
	0						PONCE LIMESTONE: ground water encountered at approx. 210 feet below surface, no free-phase hydrocarbon	Sand	SCREEN
220									
	-10								SUMP
-230									
	-20								
-240									

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MONITORING WELL

Well No: PDW-6

Project:	Off-site Delineation
Client:	CORCO
Project No.:	1069-10
Logged by:	C. R. Glore
Date:	07/29/97

Well Type:	Monitoring
Well Material:	4";PVC Casing/SS Screen
Total Depth:	138 Feet
Location:	CORCO Refinery, PR
Elevation:	125.80
Depth to Water:	118 Feet
Drilling Co.:	SoilTech Corporation
Driller:	Jorge Diaz
Drilling Method:	Air Rotary

Notes: 90 deg. F; Partly Cloudy

Depth	Elevation	Lithology	SPT	Core Recovery	USCS/PID	Samples	Lithologic Description	Well Diagram	Well Description
0	120		N/A	N/A			PONCE LIMESTONE: predominantly dry, calcareous clay with occcasional thin (<5') lenses of limestone and/or reef coral; formation varies in color from white to dark brown to gray, depending on the amount of moisture and iron staining	Grout	CASING
10	110								
20	100								
30	90								
40	80								
50	70								
60									

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MONITORING WELL

Well No: PDW-6

Project Name: Off-site Delineation
Project Number: 1069-10
Project Date: 07/29/97
Depth: 138 Feet

Depth	Elevation	Lithology	SPT	Core Recovery	USCS/PID	Samples	Lithologic Description	Well Diagram	Well Description
-70	60							Grout	CASING
-80	50								
-90	40							Bentonite	
-100	30								
-110	20								
-120	10				48 ppm	▼	Saturated; strong hydrocarbon odor in cuttings PONCE LIMESTONE: ground water encountered at approx. 117 feet below surface, hydrocarbon odor, no free-phase hydrocarbon	Sand	SCREEN
130	0								
-140	-10								SUMP

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MONITORING WELL

Well No: PDW-7

Project:	Off-site Delineation
Client:	CORCO
Project No.:	1069-10
Logged by:	C. R. Glore
Date:	11/13/97

Well Type:	Monitoring
Well Material:	4";PVC Casing/SS Screen
Total Depth:	157 Feet
Location:	West of the CORCO Refinery, PR
Elevation:	130.40
Depth to Water:	126 Feet
Drilling Co.:	SoilTech Corporation
Driller:	Jorge Diaz
Drilling Method:	Air Rotary

Notes: 90 deg. F; Partly Cloudy

Depth	Elevation	Lithology	SPT	Core Recovery	USCS/PID	Samples	Lithologic Description	Well Diagram	Well Description
0	130						PONCE LIMESTONE: predominantly dry, calcareous clay with occcasional thin (<5') lenses of limestone and/or reef coral; formation varies in color from white to dark brown to gray, depending on the amount of moisture and iron staining	Grout	CASING
10	120		N/A	N/A	N/A				
20	110								
30	100								
40	90								
50	80								
60	70								
70	60								
80									

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MONITORING WELL

Well No: PDW-7

Project Name: Off-site Delineation
Project Number: 1069-10
Project Date: 11/13/97
Depth: 157 Feet

Depth	Elevation	Lithology	SPT	Core Recovery	USCS/PID	Samples	Lithologic Description	Well Diagram	Well Description
-90	40							Grout	CASING
-100	30								
-110	20							Bentonite	
-120	10								SCREEN
-130	0					▼	PONCE LIMESTONE: ground water encountered at approx. 126 feet below surface, no free-phase hydrocarbon	Sand	
-140	-10								SUMP
-150	-20								
-160									

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MONITORING WELL

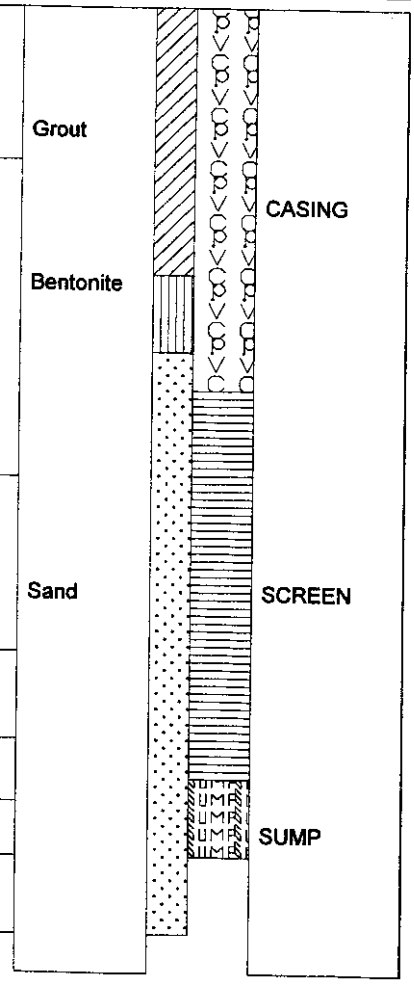
Well No: PDW-8

Project: Off-site Delineation
Client: CORCO
Project No.: 1069-10
Logged by: C. R. Glore
Date: 08/09/97

Well Type: Monitoring
Well Material: 4"; PVC Casing & Screen
Total Depth: 24 Feet
Location: CORCO Refinery, PR
Elevation: 13.98 Feet
Depth to Water: 12.4 Feet
Drilling Co.: SoilTech Corporation
Driller: Ruben Nievas
Drilling Method: Hollow Stem Auger

Notes: 90 deg. F; Partly Cloudy

Depth	Elevation	Lithology	SPT	Core Recovery	USCS/PID	Samples	Lithologic Description
0				6/24			FILL: Crushed Limestone ("caliche")
	10			0/24			
				17/24			CLAY: plastic, caliche nodules, hydrocarbon odor in top 6 feet, occasional silt lenses, dark gray
				20/24			
10			N/A	21/24	OH		
				19/24			
	0			18/24	SM		SAND AND SILT: saturated, interbedded, some shell fragments, small amount of fine, rounded gravel, probably mixed beach sand and alluvium, black
				2/24	OH		
				16/24			CLAY: saturated, plastic, dark gray, no hydrocarbon odor
-20				4/24	SW		SAND AND GRAVEL: saturated, some cobbles, sand same as above, one cobble piece is x-taline limestone
				21/24	CL		CLAY: saturated, looks like weathered Ponce Limestone
	-10			15/24	CL		CLAY: plastic, caliche nodules, lt. tan, possibly weathered Ponce Limestone



Well Diagram

Well Description

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MONITORING WELL

Well No: SWP-1

Project:	STORM WATER DESIGN
Client:	CORCO
Project No.:	1101-01
Logged by:	C.R. GLORE
Date:	09/04/97

Well Type:	PIEZOMETER
Well Material:	PVC
Total Depth:	28 FEET
Location:	NE Corner of Pond 3
Elevation:	9.49 FEET
Depth to Water:	14 FEET
Drilling Co.:	SoilTech Corporation
Driller:	JORGE DIAZ
Drilling Method:	AUGER

Notes: 95 deg.F, Partly Cloudy